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(54) A pneumatic vehicle tyre

(57) A pneumatic vehicle tyre whose carcase rubber coating is formed from a vulcanisable rubber mixture composition comprising at least 20% by weight of a styrene-butadiene copolymer having at least 30% by weight of bound styrene and 40% by weight of an additional elastomer or elastomer blend, has improved impermeability to gas whereby the intermediate pressure of the carcase is considerably reduced.

The pneumatic vehicle tyre may also be produced without an inner layer.

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A PNEUMATIC VEHICLE TYRE

The present invention relates to a pneumatic vehicle tyre. More particularly the present invention relates to a pneumatic vehicle tyre having a single-ply or multiple-ply carcase, more especially a radial carcase, whose reinforcing support members are covered by a vulcanisable rubber mixture composition, and having an inner rubber layer for the tyre formed from a vulcanisable rubber mixture with a high impermeability to gas.

In such pneumatic vehicle tyre, the tyre interior is covered by a layer of rubber which is highly impermeable to gas. This layer ensures that the compressed air is always in the tyre with the required pressure value and the necessary volume for the tyre to be capable of functioning. For this purpose, rubber mixtures preferably containing halobutyl are used for the layer of rubber which is impermeable to gas. From the point of view of costs for the raw materials, these rubber mixtures are relatively expensive and also very critical from an operational point of view because they are relatively difficult to handle. Defects are frequently produced and have to be corrected. In addition, the proportion of waste material is frequently uneconomically high. It is necessary, therefore, to supplement or substitute this butyl mixture by another equivalent mixture which is at least equally impermeable to gas.

With a pneumatic vehicle tyre, there is also the problem arising from the build-up of intermediate pressure in the carcase, such pressure being substantially influenced by the inner layer of the tyre which is impermeable to gas. From

the long-term point of view, compressed air from the tyre interior diffuses through the inner layer, which is impermeable to gas, into the carcase and, because of the high gas pressure, causes a decrease in the adhesive strength between the rubber and the carcase support members.

It is an object of the invention, therefore, to reduce this intermediate pressure in the carcase.

The invention seeks to protect the carcase from the possibility of compressed air from the interior penetrating therein, so that the passage of air through the carcase is substantially reduced to retain a high degree of adhesion between the rubber coating and the reinforcement members of the carcase and to prevent separation phenomena.

This is to be ensured by an improved carcase mixture, which is combined with an inner layer of very little thickness containing butyl rubber, or by a carcase mixture which makes this inner layer superfluous.

According to the invention, this object is achieved by an improved rubber mixture composition for the carcase, which composition is formed from a styrene-butadiene copolymer of at least 20 per cent by weight of a type with higher styrene-containing, emulsion- or solution-polymerised SBR, where the content of bound styrene is at least 30 per cent by weight, and an elastomer or elastomer blend having good adhesiveness and amounting to 40 per cent by weight, natural rubber being preferred.

The proportion of styrene-butadiene copolymer is preferably 25 to 60 per cent by weight. This improved rubber mixture composition for the carcase ensures that, from the

long-term point of view, less compressed air can diffuse, and the inner layer of halobutyl rubber, which is highly impermeable to gas, can be used in a relatively thin form.

According to an additional feature of the invention, two SBR types can be contained together in the carcase mixture, namely an SBR type 1500, with 20 per cent by weight and a styrene content of 23.5 per cent by weight, and an SBR type 1013, with 40 per cent by weight and a styrene content of 43 per cent by weight. In this case, it is entirely possible to provide the rubber coating composition for the carcase on its own, without using a separate inner layer which is impermeable to air. In this respect, the tyre interior is defined by the carcase itself and not by the inner layer of rubber normally used otherwise.

Such a carcase rubber coating has the property of a greater or lesser impermeability to gas, with at least 20 per cent by weight, wherein the styrene content is at least 30 per cent by weight in the elastomer molecule, and has the desired property of a requisite, relatively high impermeability to gas. This rubber coating may be combined with a very thin halobutyl layer to achieve the aim and object of the invention.

If an SBR type is used which contains at least 20 per cent by weight with a higher bound or combined styrene content, it is possible to omit the halobutyl layer totally.

Because it is desirable, for tyre manufacture to provide adhesiveness between the rubber coating composition, the carcase reinforcing support members and the adjacent rubber component constituents of the tyre, a type of rubber which promotes adhesiveness is used in addition to the SBR type. This is preferably a natural rubber, a polyisoprene or

a normal SBR type with a low styrene content. These mixture constituents do not adversely affect the property of impermeability to gas of the mixture constituents of the carcase proposed by the invention.

The reinforcing support members of the carcase may be produced from rayon, nylon, polyester or polyamide materials. These carcase materials are covered on all sides with the rubber mixture composition for the carcase according to the invention. In consequence, there are possibilities for a symmetrical covering, that is to say a covering of identical thickness, or an asymmetrical covering whereby, in this case, the upper and lower covering layers vary in thickness.

The invention is explained with reference to examples which compare the carcase mixture of the invention with a standard carcase mixture.

Table 1

Composition	Standard	A	B
(100 parts by weight per 100 parts by weight of rubber			
Natural rubber	50	40	40
Polybutadin (BR)	20	-	-
Styrene-butadiene-copolymer mixture (SBR) 1500	30	-	20
Styrene-butadiene copolymer mixture (SBR) 1013	-	60	40
Soot GPF N-660	45	35	85
Aromatic oil	8	8	9
Sulphur	0.25	0.25	0.25

Property:

Impermeability to gas		Standard	A	B
$\left(\frac{m^2}{s \cdot P_a} 10^{17}\right)$	30°C	8.6	3.8	3.6
at	50°C	21.0	10.3	8.9
	70°C	37.0	20.4	18.1

The recipe of the carcase mixture according to Table 1, as proposed by the invention, shows that there is less impermeability to air in three temperature regions included in the comparison, namely in the region of 30°C, 50°C and 70°C. The values of the impermeability to air are considerably improved compared with the values of the standard rubber mixture.

In the regions of 30° and 50°, mixture A is already more than 50% more impermeable than the standard mixture. These values are improved upon again with mixture B. In the region of 70°C, the value also shows an improvement of more than 50% in respect of the impermeability to gas compared with the value for the standard rubber mixture composition.

Table 2 shows the improvement of the intermediate pressure value of the carcase when comparing the carcase rubber mixture of the invention with the standard carcase mixture.

Table 2

Tyre	Tyre 1	Tyre 2
Size	195/70 SR 14	195/70 SR 14
Design	Rallye 340/70	Rallye 340/70
Type	tubeless	tubeless
Carcase material	Rayon 1840/2	Rayon 1840/2
Carcase rubber coating	Standard	B
Coating thickness	1.22 symmetrical	1.22 symmetrical
Inner layer of tyre	none	none
Operational air pressure for the tyre (bar)	2.0	2.0
Intermediate pressure of carcase		
% of operational air pressure	70	52.5

In the case of the carcase mixture according to the invention, the intermediate pressure value of the carcase is only 52.5% of the operational air pressure value of the tyre of 2 bars, namely 2.0 x 0.525 = 1.05 bar. In comparison therewith, the intermediate pressure value of the carcase is always 0.7 x 2.0 = 1.4 bar high, when a standard mixture

composition for the carcase is without an inner layer.

Rubber mixtures with higher styrene contents are known per se. According to German Offenlegungsschrift No. 2 737 234, it is known to provide a special sealing layer between the carcase and the belt-like insert ply. This sealing layer is formed from an SBR type, whose styrene content is preferably 40 to 100 parts by weight per 100 parts of rubber.

The object of this sealing layer is to limit the migration of moisture.

According to German Patent Specification No. 3 432 148, it is known to provide the styrene content up to 20 per cent by weight and the content of isolated styrene units at 40% and more when there is a tread surface rubber mixture of 30 per cent by weight or more of SBR and the remainder of the mixture composition is formed from natural rubber with the SBR type. This promotes the wetness property and a low rolling resistance at low external temperatures.

According to German Auslegeschrift No. 1 182 973, it is known to provide a hard rubber layer between the carcase and the belt-like insert ply. This mixture is formed from an SBR type of rubber containing more than 25 per cent by weight of styrene units. In consequence, a high transverse rigidity of the region between the carcase and the belt-like insert ply is achieved.

With the invention, however, a rubber coating mixture for the carcase is proposed which is highly impermeable to air, or the permeability to air of the pneumatic tyre is considerably limited in combination with a relatively thin

inner layer of halobutyl rubber mixture. In addition, with the carcase mixture according to the invention, it is proposed to employ two different SBR types which have different levels of styrene content. Thus, it is possible to omit totally the separate inner layer formed from halobutyl. In consequence, the rubber mixture of the carcase is also additionally suitable for solely achieving a high impermeability to gas.

At the same time, an improvement is thus far achieved because the intermediate pressure of the carcase is considerably reduced to a greater or lesser extent by the use of one of the rubber mixtures of the invention for the carcase. This is essential for the life of the carcase because, in consequence, the gas pressure is less high, and the diffusing therefore exerts far less influence. Hence, in particular, the adhesive strength between the rubber coating composition and the reinforcing support members of the carcase is considerably enhanced.

Furthermore, advantages are achieved in respect of the costs for the raw materials; because, if only a very thin halobutyl layer is used, these costs are less and, if halobutyl is totally omitted, the costs which are saved are considerable. It is also possible to omit the difficult, technical handling of halobutyl. Far fewer defects are produced, and there is less waste with a carcase mixture according to the invention.

CLAIMS

1. A pneumatic vehicle tyre having a single-ply or multiple-ply carcase, more especially a radial carcase, whose reinforcing support members are covered by a vulcanisable rubber mixture composition, and having an inner rubber layer for the tyre formed from a vulcanisable rubber mixture with a high impermeability to gas, wherein the rubber mixture composition for the carcase is formed from at least 20 per cent by weight of a higher styrene-containing, emulsion- or solution-polymerised styrene-butadiene copolymer (E- SBR or S- SBR), wherein the content of bound styrene is at least 30 per oent by weight, and 40 per cent by weight of an elastomer or elastomer blend having good adhesiveness.

2. A pneumatic vehicle tyre as claimed in claim 1, wherein there is a higher styrene-containing SBR type in an amount of 25 to 60 per cent by weight.

3. A pneumatic vehicle tyre as claimed in claim 1 or 2, wherein an SBR type 1500, amounting to 20 per cent by weight, has a 23.5 per cent by weight of styrene, and an SBR type 1013, amounting to 40 per cent by weight, has 43 per cent by weight of styrene in the carcase mixture.

4. A pneumatic vehicle tyre as claimed in claim 1, 2 or 3, characterised by a carcase for the pneumatic vehicle tyre not having an inner layer.

5. A pneumatic vehicle tyre substantially as hereinbefore described adn exemplified.